

General Description

The LM4040 is a precision two-terminal shunt mode, bandgap voltage reference available in fixed reverse breakdown voltages of 2.048V, 2.500V, 3.000V, 3.3V, 4.096V, and 5.000V. Ideal for space-critical applications, the LM4040 is offered in the subminiature 3-pin SC70 surface-mount package (1.8mm × 1.8mm), 50% smaller than comparable devices in SOT23 surfacemount packages (SOT23 versions are also available).

Laser-trimmed resistors ensure precise initial accuracy. With a 100ppm/°C temperature coefficient, the device is offered in four grades of initial accuracy ranging from 0.1% to 1%. The LM4040 has a 60µA to 15mA shunt current capability with low dynamic impedance, ensuring stable reverse breakdown voltage accuracy over a wide range of operating temperatures and currents.

The LM4040 does not require an external stabilizing capacitor while ensuring stability with any capacitive load.

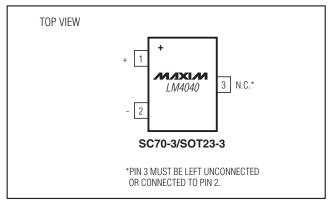
The LM4040 is guaranteed over the temperature range of -40°C to +125°C.

For a 1.225V output version, refer to the LM4041 data sheet.

Applications

Portable, Battery-Powered Equipment Notebook Computers Cell Phones Industrial Process Controls

Pin Configuration



Ordering Information appears at end of data sheet.

Features

- ♦ Ultra-Small 3-Pin SC70 Package
- ♦ 0.1% (max) Initial Accuracy
- ♦ 100ppm/°C (max) Temperature Coefficient Guaranteed over -40°C to +125°C Temperature Range
- ♦ Wide Operating Current Range: 60µA to 15mA
- ♦ Low 28µV_{RMS} Output Noise (10Hz to 10kHz)
- ♦ 2.048V, 2.500V, 3.000V, 3.3V, 4.096V, and 5.000V **Fixed Reverse Breakdown Voltages**
- ♦ No Output Capacitors Required
- **♦ Tolerates Capacitive Loads**

Selector Guide

PART	TEMP RANGE	PIN- PACKAGE	OUTPUT VOLTAGE (V)
LM4040_IM3-2.1+T	-40°C to +85°C	3 SOT23	2.048
LM4040_IX3-2.1+T	-40°C to +85°C	3 SC70	2.048
LM4040_EM3-2.1+T	-40°C to +125°C	3 SOT23	2.048
LM4040_EX3-2.1+T	-40°C to +125°C	3 SC70	2.048
LM4040_IM3-2.5+T	-40°C to +85°C	3 SOT23	2.500
LM4040_IX3-2.5+T	-40°C to +85°C	3 SC70	2.500
LM4040_IM3-2.5/V+T	-40°C to +85°C	3 SC70	2.500
LM4040_EM3-2.5+T	-40°C to +125°C	3 SOT23	2.500
LM4040_EM3-2.5/V+T	-40°C to +125°C	3 SOT23	2.500
LM4040_EX3-2.5+T	-40°C to +125°C	3 SC70	2.500
LM4040_IM3-3.0+T	-40°C to +85°C	3 SOT23	3.000
LM4040_IX3-3.0+T	-40°C to +85°C	3 SC70	3.000
LM4040_EX3-3.0+T	-40°C to +125°C	3 SC70	3.000
LM4040_EX3-3.3+T	-40°C to +125°C	3 SC70	3.300
LM4040_IM3-4.1+T	-40°C to +85°C	3 SOT23	4.096
LM4040_IX3-4.1+T	-40°C to +85°C	3 SC70	4.096
LM4040_EM3-4.1	-40°C to +125°C	3 SOT23	4.096
LM4040_EM3-4.1/V+T	-40°C to +125°C	3 SOT23	4.096
LM4040_EX3-4.1+T	-40°C to +125°C	3 SC70	4.096
LM4040_IM3-5.0+T	-40°C to +85°C	3 SOT23	5.000
LM4040_IX3-5.0+T	-40°C to +85°C	3 SC70	5.000
LM4040_EM3-5.0+T	-40°C to +125°C	3 SOT23	5.000
LM4040_EM3-5.0/V+T	-40°C to +125°C	3 SOT23	5.000
LM4040_EX3-5.0+T	-40°C to +125°C	3 SC70	5.000

⁺Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

ABSOLUTE MAXIMUM RATINGS

Reverse Current (cathode to anode)	20mA
Forward Current (anode to cathode)	10mA
Continuous Power Dissipation (T _A = +70°C)	
3-Pin SC70 (derate 2.17mW/°C above +70°C)	174mW
3-Pin SOT23 (derate 4.01mW/°C above +70°C).	

Operating Temperature Range	
LM4040_I	40°C to +85°C
LM4040_E	40°C to +125°C
Storage Temperature Range	65°C to +150°C
Junction Temperature	+150°C
Lead Temperature (soldering, 10s)	+300°C
Soldering Temperature (reflow)	+260°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS-2.048V

 $(I_R = 100\mu A, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } T_A = +25^{\circ}\text{C.})$ (Note 1)

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS	
			LM4040A (0.1%)	2.046	2.048	2.050		
Davis va a Dua ali ali si va Malta si a	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	T 0500	LM4040B (0.2%)	2.044	2.048	2.052	- v	
Reverse Breakdown Voltage	VR	T _A = +25°C	LM4040C (0.5%)	2.038	2.048	2.058		
			LM4040D (1.0%)	2.028	2.048	2.068		
		LM4040A			±2.0	±15		
Reverse Breakdown Voltage Tolerance (Note 2)	\/-	LM4040B			±4.0	±17	\/	
	VR	LM4040C			±10	±23	mV	
		LM4040D			±20	±41		
NA:-:	1	LM4040A/B/C			45	65		
Minimum Operating Current	I _{RMIN}	LM4040D		45	70	μΑ		
		$I_R = 10 \text{mA}$		±20				
Average Reverse Voltage	ΔV _R /ΔT	le 1m1	LM4040A/B/C		±15	±100	10 to 100	
Temperature Coefficient (Notes 2 and 3)		$I_R = 1mA$	LM4040D		±15	±150	ppm/°C	
(10100 2 41.4 0)		I _R = 100μA			±15			
			LM4040A/B/C		0.3	1.0		
Reverse Breakdown Voltage		$I_{RMIN} \le I_R \le 1mA$	LM4040D		0.3	1.2	>/	
Change with Operating Current Change		1 mg A < 1 - < 1 F mg A	LM4040A/B/C		2.5	8.0	mV	
Surrent Sharige		1mA ≤ I _R ≤ 15mA	LM4040D		2.5	10.0]	
			LM4040A/B		0.3	0.8		
Reverse Dynamic	Z_{R}	$I_R = 1 \text{mA}, f = 120 \text{Hz},$ $I_{AC} = 0.1 \text{I}_R$	LM4040C		0.3	0.9	Ω	
Impedance (Note 3)		IAC - 0.11R	LM4040D		0.3	1.1	1	
Wideband Noise	eN	I _R = 100μA, 10Hz ≤ f ≤ 10kHz			28		μV _{RMS}	
Reverse Breakdown Voltage Long-Term Stability	ΔV _R	T = 1000h		120		ppm		

ELECTRICAL CHARACTERISTICS—2.500V

 $(I_R = 100 \mu A, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } T_A = +25 ^{\circ}\text{C.}) \text{ (Note 1)}$

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS
			LM4040A (0.1%)	2.4975	2.5000	2.5025	
Daylorga Draglydaylin Valtaga	\/-	T .0500	LM4040B (0.2%)	2.4950	2.5000	2.5050] V
Reverse Breakdown Voltage	VR	T _A = +25°C	LM4040C (0.5%)	2.4875	2.5000	2.5125]
			LM4040D (1.0%)	2.4750	2.5000	2.5250	
		LM4040A			±2.0	±19	
Reverse Breakdown Voltage Tolerance (Note 2)	V _R	LM4040B			±4.0	±21	mV
	VR	LM4040C			±10	±29	IIIV
		LM4040D			±20	±49	
Minimum Operating Current	le	LM4040A/B/C			45	65	μA
Willimum Operating Current	I _{RMIN}	LM4040D		45	70	μΑ	
		$I_R = 10 \text{mA}$		±20			
Average Reverse Voltage Temperature Coefficient	$\Delta V_R/\Delta T$	$I_{R} = 1 \text{mA}$	LM4040A/B/C		±15	±100	ppm/°C
(Notes 2 and 3)		IR = IIIIA	LM4040D		±15	±150] ppm/·C
(10100 2 41.4 0)		I _R = 100μA			±15		
		I _{RMIN} ≤I _R ≤1mA	LM4040A/B/C		0.3	1.0	
Reverse Breakdown Voltage Change with Operating		IRMIN > IR > IIIIA	LM4040D		0.4	1.2	mV
Current Change		1mA ≤ I _R ≤ 15mA	LM4040A/B/C		2.5	8.0	IIIV
		IIIIA Z IKZ IOIIIA	LM4040D		2.5	10.0	
			LM4040A/B		0.3	0.8	
Reverse Dynamic Impedance (Note 3)	Z_{R}	$I_R = 1 \text{mA}, f = 120 \text{Hz},$ $I_{AC} = 0.1 \text{I}_R$	LM4040C		0.3	0.9	Ω
Impedance (Note 3)		IAC = 0.11R	LM4040D		0.3	1.1]
Wideband Noise	eN	I _R = 100μA, 10Hz ≤ f ≤ 10kHz			35		μV _{RMS}
Reverse Breakdown Voltage Long-Term Stability	ΔVR	T = 1000h			120		ppm

ELECTRICAL CHARACTERISTICS—3.000V

 $(I_R = 100\mu A, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } T_A = +25^{\circ}\text{C.})$ (Note 1)

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS
			LM4040A (0.1%)	2.997	3.000	3.003	
Dayaraa Draakdayya Valtaga	\/-	T 0500	LM4040B (0.2%)	2.994	3.000	3.006]
Reverse Breakdown Voltage	VR	$T_A = +25^{\circ}C$	LM4040C (0.5%)	2.985	3.000	3.015	i V
			LM4040D (1.0%)	2.970	3.000	3.030	
		LM4040A			±3.0	±22	
Reverse Breakdown Voltage Tolerance (Note 2)	\/-	LM4040B			±6.0	±26	\ /
	VR	LM4040C			±15	±34	mV
		LM4040D			±30	±59	
Minimum Operating Current	lovani	LM4040A/B/C			45	67	
Minimum Operating Current	I _{RMIN}	LM4040D		45	70	μΑ	
		$I_R = 10mA$		±20			
Average Reverse Voltage Temperature Coefficient	$\Delta V_R/\Delta T$	I _R = 1mA	LM4040A/B/C		±15	±100	nnm/°C
(Notes 2 and 3)		I IK = IIIIA	LM4040D		±15	±150	ppm/°C
(**************************************		I _R = 100μA			±15		
			LM4040A/B/C		0.3	1.0	
Reverse Breakdown Voltage Change with Operating		$I_{RMIN} \le I_R \le 1mA$	LM4040D		0.3	1.2	\ /
Current Change		1m \ < \ < 1 \ 1 \	LM4040A/B/C		2.5	8.0	mV
		1mA ≤ I _R ≤ 15mA	LM4040D		2.5	10.0	
			LM4040A/B		0.3	8.0	
Reverse Dynamic Impedance (Note 3)	Z_{R}	$I_R = 1 \text{mA}, f = 120 \text{Hz},$ $I_{AC} = 0.1 \text{I}_R$	LM4040C		0.3	0.9	Ω
Impedance (Note 3)		IAC = 0.11K	LM4040D		0.3	1.1	
Wideband Noise	eN	I _R = 100μA, 10Hz ≤ f ≤ 10kHz			45		μV _{RMS}
Reverse Breakdown Voltage Long-Term Stability	ΔVR	T = 1000h			120		ppm

ELECTRICAL CHARACTERISTICS—3.300V

 $(I_R = 100\mu A, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } T_A = +25^{\circ}\text{C.})$ (Note 1)

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS
			LM4040A (0.1%)	3.2967	3.3000	3.3033	
Devene Dreek deve Velte se	\/_	T 050C	LM4040B (0.2%)	3.2934	3.3000	3.3066	<u> </u>
Reverse Breakdown Voltage	VR	T _A = +25°C	LM4040C (0.5%)	3.2835	3.3000	3.3165	ĺ
			LM4040D (1.0%)	3.2670	3.3000	3.3330	
		LM4040A			±3.0	±22	
Reverse Breakdown Voltage	\/=	LM4040B			±6.0	±26	m\/
Tolerance (Note 2)	VR	LM4040C			±15	±34	mV
		LM4040D			±30	±59	
Minimum On antinan On anti-	les m.	LM4040A/B/C			45	67	
Minimum Operating Current	I _{RMIN}	LM4040D		45	70	μΑ	
		$I_R = 10mA$		±20			
Average Reverse Voltage	$\Delta V_R/\Delta T$	I _B = 1mA	LM4040A/B/C		±15	±100	nnm/0C
Temperature Coefficient (Notes 2 and 3)		IK = IIIIA	LM4040D		±15	±150	ppm/°C
(1.10100 2 41.10 0)		$I_{R} = 100 \mu A$			±15		
		I _{RMIN} ≤I _R ≤1mA	LM4040A/B/C		0.3	1.0	
Reverse Breakdown Voltage		IRMIN > IR > IIIIA	LM4040D		0.3	1.2	mV
Change with Operating Current Change		1m \ < \ < 1 \ 1 \	LM4040A/B/C		2.5	8.0	IIIV
Same Shange		1mA ≤ I _R ≤ 15mA	LM4040D		2.5	10.0	
			LM4040A/B		0.3	0.8	
Reverse Dynamic Impedance (Note 3)	Z _R	$I_R = 1 \text{mA}, f = 120 \text{Hz},$ $I_{AC} = 0.1 I_R$	LM4040C		0.3	0.9	Ω
impedance (Note 3)		IAC = 0.11R	LM4040D		0.3	1.1	
Wideband Noise	eN	I _R = 100μA, 10Hz ≤ f ≤ 10kHz			50		μVRMS
Reverse Breakdown Voltage Long-Term Stability	ΔV_{R}	T = 1000h			120		ppm

ELECTRICAL CHARACTERISTICS-4.096V

 $(I_R = 100 \mu A, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } T_A = +25 ^{\circ}\text{C.}) \text{ (Note 1)}$

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS
			LM4040A (0.1%)	4.092	4.096	4.100	
Doversa Progledown Voltage	V _R	T _A = +25°C	LM4040B (0.2%)	4.088	4.096	4.104	V
Reverse Breakdown Voltage	VR	IA = +25°C	LM4040C (0.5%)	4.076	4.096	4.116	\ \ \
			LM4040D (1.0%)	4.055	4.096	4.137	
		LM4040A			±4.1	±31	
Reverse Breakdown Voltage Tolerance (Note 2)	\/-	LM4040B			±8.2	±35	mV
	VR	LM4040C			±20	±47	mv
		LM4040D			±41	±81	
Minimum On anating Organis	le	LM4040A/B/C			50	73	
Minimum Operating Current	I _{RMIN}	LM4040D		50	78	μΑ	
	$\Delta V_R/\Delta T$	$I_R = 10mA$		±30			
Average Reverse Voltage Temperature Coefficient		I _R = 1mA	LM4040A/B/C		±20	±100	ppm/°C
(Notes 2 and 3)		IK = IIIIA	LM4040D		±20	±150	
(110000 = 0.1100 0)		I _R = 100μA			±15		
		I _{RMIN} ≤ I _R ≤ 1mA	LM4040A/B/C		0.5	1.2	
Reverse Breakdown Voltage Change with Operating		IRMIN > IR > IIIIA	LM4040D		0.5	1.5	mV
Current Change		1mA ≤ I _B ≤ 15mA	LM4040A/B/C		3.0	10.0	IIIV
		IIIIA Z IKZ IOIIIA	LM4040D		3.0	13.0	
Reverse Dynamic	75	$I_R = 1 \text{mA}, f = 120 \text{Hz},$	LM4040A/B/C		0.5	1.0	Ω
Impedance (Note 3)	mpedance (Note 3)		LM4040D		0.5	1.3	52
Wideband Noise	e _N	I _R = 100μA, 10Hz ≤ f ≤ 10kHz			64		μV _{RMS}
Reverse Breakdown Voltage Long-Term Stability	ΔV _R	T = 1000h			120		ppm

ELECTRICAL CHARACTERISTICS-5.000V

(I_R = 100μA, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDI	TIONS	MIN	TYP	MAX	UNITS	
			LM4040A (0.1%)	4.995	5.000	5.005		
Dovorgo Progledowa Voltago	VR	T050C	LM4040B (0.2%)	4.990	5.000	5.010	 	
Reverse Breakdown Voltage	VR	T _A = +25°C	LM4040C (0.5%)	4.975	5.000	5.025		
			LM4040D (1.0%)	4.950	5.000	5.050		
		LM4040A			±5.0	±38		
Reverse Breakdown Voltage	VR	LM4040B			±10	±43	mV	
Tolerance (Note 2)	VR	LM4040C			±25	±58	IIIV	
		LM4040D			±50	±99		
Minimum Oranatina Current	lovani	LM4040A/B/C		54	80			
Minimum Operating Current	I _{RMIN}	LM4040D		54	85	μΑ		
	$\Delta V_{B}/\Delta T$	$I_R = 10 \text{mA}$		±30				
Average Reverse Voltage Temperature Coefficient		I _R = 1mA	LM4040A/B/C		±20	±100	nnm/°C	
(Notes 2 and 3)	Δν Κ/Δ1	IR = 1111A LM4040D			±20	±150	ppm/°C	
(1.11.10.00 = 0.11.10.00)		I _R = 100μA			±15			
		I _{RMIN} ≤I _R ≤ 1mA	LM4040A/B/C		0.5	1.4		
Reverse Breakdown Voltage Change with Operating		IRMIN > IR > IIIIA	LM4040D		0.5	1.8	mV	
Current Change		1mA ≤ I _R ≤ 15mA	LM4040A/B/C		3.5	12.0	IIIV	
Can one Change		IIIIA Z IŠZ ISIIIA	LM4040D		3.5	15.0		
Reverse Dynamic	70	$I_R = 1 \text{mA}, f = 120 \text{Hz},$	LM4040A/B/C		0.5	1.1	Ω	
Impedance (Note 3)	Z _R	$I_{AC} = 0.1I_{R}$	LM4040D		0.5	1.5	52	
Wideband Noise	eN	$I_{R} = 100\mu A, 10Hz \le f \le 10kHz$			80		μV _{RMS}	
Reverse Breakdown Voltage Long-Term Stability	ΔV _R	T = 1000h		120		ppm		

Note 1: All devices are 100% production tested at T_A = +25°C and are guaranteed by design for T_A = T_{MIN} to T_{MAX}, as specified.

Note 2: The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room-temperature Reverse Breakdown Voltage Tolerance $\pm [(\Delta V_R/\Delta T)(max\Delta T)(V_R)]$, where $\Delta V_R/\Delta T$ is the V_R temperature coefficient, $max\Delta T$ is the maximum difference in temperature from the reference point of $+25^{\circ}C$ to T_{MIN} or T_{MAX} , and V_R is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the temperature range where $max\Delta T = +65^{\circ}C$ is shown below:

A grade: $\pm 0.75\% = \pm 0.1\% \pm 100$ ppm/°C × 65°C

B grade: $\pm 0.85\% = \pm 0.2\% \pm 100$ ppm/°C × 65°C

C grade: $\pm 1.15\% = \pm 0.5\% \pm 100$ ppm/°C × 65°C

D grade: $\pm 1.98\% = \pm 1.0\% \pm 150$ ppm/°C × 65°C

The total over-temperature tolerance for the different grades in the extended temperature range where max $\Delta T = +100$ °C is shown below:

A grade: $\pm 1.1\% = \pm 0.1\% \pm 100$ ppm/°C × 100°C

B grade: $\pm 1.2\% = \pm 0.2\% \pm 100$ ppm/°C × 100°C

C grade: $\pm 1.5\% = \pm 0.5\% \pm 100$ ppm/°C × 100°C

D grade: $\pm 2.5\% = \pm 1.0\% \pm 150$ ppm/°C × 100°C

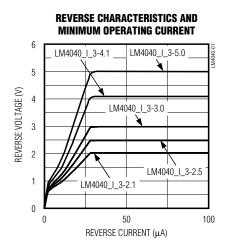
Therefore, as an example, the A-grade LM4040-2.5 has an over-temperature reverse breakdown voltage tolerance of $\pm 2.5 \text{V} \times 0.75\% = \pm 19 \text{mV}$.

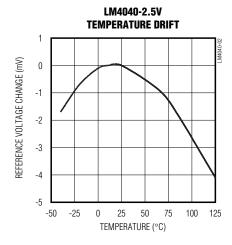
Note 3: Guaranteed by design.

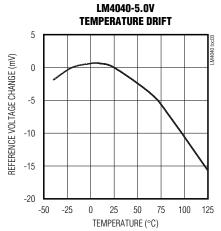


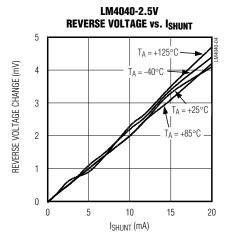
Typical Operating Characteristics

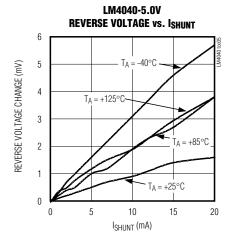
(I_R = 100μA, SC70-3 package, T_A = +25°C, unless otherwise noted.)











LM4040

Improved Precision Micropower Shunt Voltage Reference with Multiple Reverse Breakdown Voltages

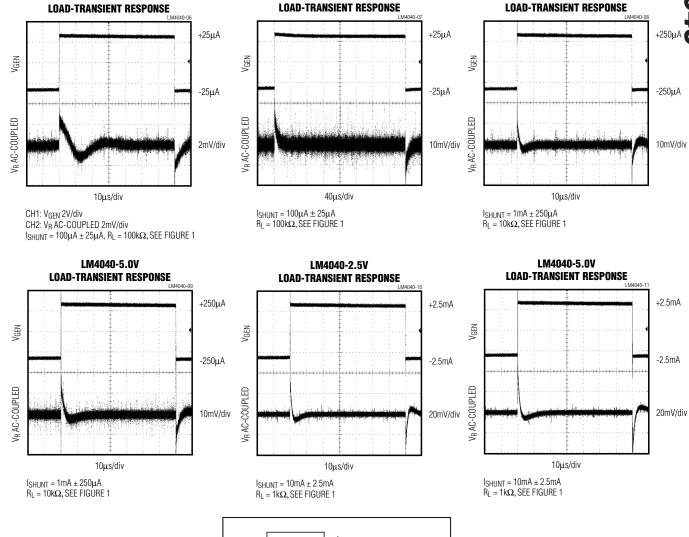
LM4040-5.0V

Typical Operating Characteristics (continued)

LM4040-2.5V

 $(I_R = 100\mu A, SC70 \text{ package}, T_A = +25^{\circ}C, \text{ unless otherwise noted.})$

LM4040-2.5V



ISHUNT

 V_{GEN}

Figure 1. Load-Transient Test Circuit

Typical Operating Characteristics (continued)

($I_R = 100\mu A$, SC70 package, $T_A = +25$ °C, unless otherwise noted.)

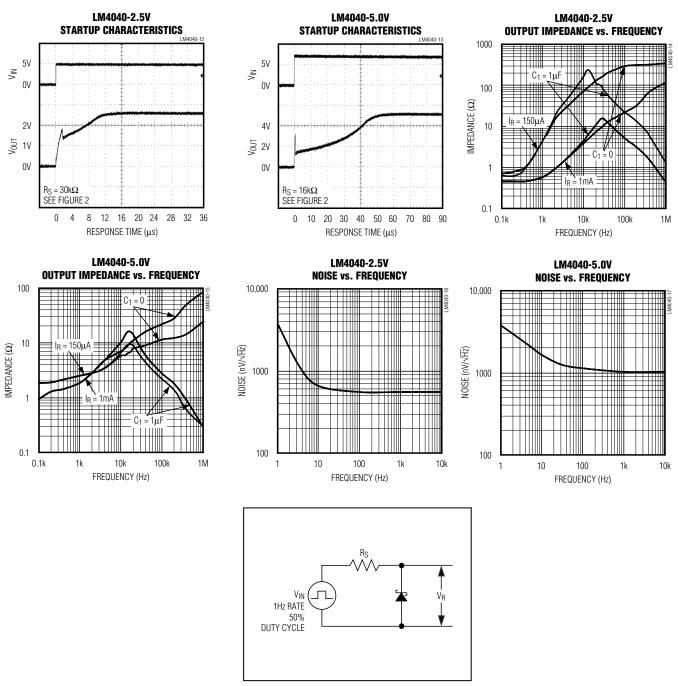


Figure 2. Startup Characteristics Test Circuit

Pin Description

PIN	NAME	FUNCTION
1	+	Positive Terminal of the Shunt Reference
2	-	Negative Terminal of the Shunt Reference
3	N.C.	No connection. Leave this pin unconnected or connected to pin 2.

Detailed Description

The LM4040 shunt references use the bandgap principle to produce a stable, accurate voltage. The device behaves similarly to an ideal zener diode; a fixed voltage is maintained across its output terminals when biased with $60\mu A$ to 15mA of reverse current. The LM4040 behaves similarly to a silicon diode when biased with forward currents up 10mA.

Figure 3 shows a typical operating circuit. The LM4040 is ideal for providing a stable reference from a high-voltage power supply.

Applications Information

The LM4040's internal pass transistor is used to maintain a constant output voltage (V_{SHUNT}) by sinking the necessary amount of current across a source resistor. The source resistance (R_S) is determined from the load current (I_{LOAD}) range, supply voltage (V_S) variations, V_{SHUNT}, and desired quiescent current.

Choose the value of Rs when Vs is at a minimum and I_{LOAD} is at a maximum. Maintain a minimum I_{SHUNT} of $60\mu A$ at all times. The Rs value should be large enough to keep I_{SHUNT} less than 15mA for proper regulation when Vs is maximum and I_{LOAD} is at a minimum. To prevent damage to the device, I_{SHUNT} should never exceed 20mA.

Therefore, the value of $\ensuremath{\mathsf{R}}_S$ is bounded by the following equation:

Choosing a larger resistance minimizes the total power dissipation in the circuit by reducing the shunt current ($P_{D(TOTAL)} = V_S \times I_{SHUNT}$). Provide a safety margin to incorporate the worst-case tolerance of the resistor used. Ensure that the resistor's power rating is adequate, using the following general power equation:

PDR = ISHUNT × (VS(MAX) - VSHUNT)

Output Capacitance

The LM4040 does not require an external capacitor for frequency stability and is stable for any output capacitance.

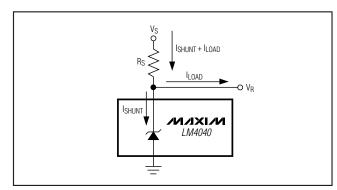


Figure 3. Typical Operating Circuit

Temperature Performance

The LM4040 typically exhibits an output voltage temperature coefficient within ±15ppm/°C. The polarity of the temperature coefficient may be different from one device to another; some may have positive coefficients, and others may have negative coefficients.

High Temperature Operation

The maximum junction temperature of the LM4040 is +150°C. The maximum operating temperature for the LM4040_E_ is +125°C. At a maximum load current of 15mA and a maximum output voltage of 5V, the part will dissipate 75mW of power. The power dissipation limits of the 3-pin SC70 call for a derating value of 2.17mW/°C above +70°C and thus for 75mW of power dissipation, the part will selfheat to 35.56°C above ambient temperature. If the ambient temperature is +125°C, the part operates at 159.56°C, thereby exceeding the maximum junction temperature value of +150°C. For high-temperature operation, care must be taken to ensure the combination of ambient temperature, output power dissipation and package thermal resistance does not conspire to raise the device temperature beyond that listed in the Absolute Maximum Ratings. Either reduce the output load current or the ambient temperature to keep the part within the limits.

Ordering Information

PART	OUTPUT VOLTAGE (V)	INITIAL ACCURACY (%)	TEMPCO (ppm/°C)	TEMP RANGE	PIN-PACKAGE	TOP MARK
LM4040AIM3-2.1+T	2.048	0.1	100	-40°C to +85°C	3 SOT23	FZEF
LM4040AIX3-2.1+T	2.048	0.1	100	-40°C to +85°C	3 SC70	ABJ
LM4040BIM3-2.1+T	2.048	0.2	100	-40°C to +85°C	3 SOT23	FZEG
LM4040BIX3-2.1+T	2.048	0.2	100	-40°C to +85°C	3 SC70	ABK
LM4040CIM3-2.1+T	2.048	0.5	100	-40°C to +85°C	3 SOT23	FZEH
LM4040CIX3-2.1+T	2.048	0.5	100	-40°C to +85°C	3 SC70	ABL
LM4040DIM3-2.1+T	2.048	1.0	150	-40°C to +85°C	3 SOT23	FZEI
LM4040DIX3-2.1+T	2.048	1.0	150	-40°C to +85°C	3 SC70	ABM
LM4040AEM3-2.1+T	2.048	0.1	100	-40°C to +125°C	3 SOT23	FZNG
LM4040AEX3-2.1+T	2.048	0.1	100	-40°C to +125°C	3 SC70	ALF
LM4040BEM3-2.1-T	2.048	0.2	100	-40°C to +125°C	3 SOT23	FZNH
LM4040BEX3-2.1-T	2.048	0.2	100	-40°C to +125°C	3 SC70	ALG
LM4040CEM3-2.1-T	2.048	0.5	100	-40°C to +125°C	3 SOT23	FZNI
LM4040CEX3-2.1+T	2.048	0.5	100	-40°C to +125°C	3 SC70	ALH
LM4040DEM3-2.1+T	2.048	1.0	150	-40°C to +125°C	3 SOT23	FZNJ
LM4040DEX3-2.1+T	2.048	1.0	150	-40°C to +125°C	3 SC70	ALI
LM4040AIM3-2.5+T	2.500	0.1	100	-40°C to +85°C	3 SOT23	FZEJ
LM4040AIX3-2.5+T	2.500	0.1	100	-40°C to +85°C	3 SC70	ABN
LM4040BIM3-2.5+T	2.500	0.2	100	-40°C to +85°C	3 SOT23	FZEK
LM4040BIM3-2.5/V+T	2.500	0.2	100	-40°C to +125°C	3 SOT23	FZWL
LM4040BIX3-2.5+T	2.500	0.2	100	-40°C to +85°C	3 SC70	ABO
LM4040CIM3-2.5+T	2.500	0.5	100	-40°C to +85°C	3 SOT23	FZEL
LM4040CIX3-2.5+T	2.500	0.5	100	-40°C to +85°C	3 SC70	ABP
LM4040DIM3-2.5+T	2.500	1.0	150	-40°C to +85°C	3 SOT23	FZEM
LM4040DIX3-2.5+T	2.500	1.0	150	-40°C to +85°C	3 SC70	ABQ
LM4040AEM3-2.5+T	2.500	0.1	100	-40°C to +125°C	3 SOT23	FZNK
LM4040AEX3-2.5+T	2.500	0.1	100	-40°C to +125°C	3 SC70	ALJ
LM4040BEM3-2.5+T	2.500	0.2	100	-40°C to +125°C	3 SOT23	FZNL
LM4040BEX3-2.5+T	2.500	0.2	100	-40°C to +125°C	3 SC70	ALK
LM4040CEM3-2.5+T	2.500	0.5	100	-40°C to +125°C	3 SOT23	FZNM
LM4040CEM3-2.5/V+T	2.500	0.5	100	-40°C to +125°C	3 SOT23	FZVZ
LM4040CEX3-2.5+T	2.500	0.5	100	-40°C to +125°C	3 SC70	ALL
LM4040DEM3-2.5+T	2.500	1.0	150	-40°C to +125°C	3 SOT23	FZNN
LM4040DEX3-2.5+T	2.500	1.0	150	-40°C to +125°C	3 SC70	ALM

⁺Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

Ordering Information (continued)

PART	OUTPUT VOLTAGE (V)	INITIAL ACCURACY (%)	TEMPCO (ppm/°C)	TEMP RANGE	PIN-PACKAGE	TOP MARK
LM4040AIM3-3.0+T	3.000	0.1	100	-40°C to +85°C	3 SOT23	FZEN
LM4040AIX3-3.0+T	3.000	0.1	100	-40°C to +85°C	3 SC70	ABR
LM4040BIM3-3.0+T	3.000	0.2	100	-40°C to +85°C	3 SOT23	FZEO
LM4040BIX3-3.0+T	3.000	0.2	100	-40°C to +85°C	3 SC70	ABS
LM4040CIM3-3.0+T	3.000	0.5	100	-40°C to +85°C	3 SOT23	FZEP
LM4040CIX3-3.0+T	3.000	0.5	100	-40°C to +85°C	3 SC70	ABT
LM4040DIM3-3.0+T	3.000	1.0	150	-40°C to +85°C	3 SOT23	FZEQ
LM4040DIX3-3.0+T	3.000	1.0	150	-40°C to +85°C	3 SC70	ABU
LM4040AEM3-3.0+T	3.000	0.1	100	-40°C to +125°C	3 SOT23	FZNO
LM4040AEX3-3.0+T	3.000	0.1	100	-40°C to +125°C	3 SC70	ALN
LM4040BEM3-3.0+T	3.000	0.2	100	-40°C to +125°C	3 SOT23	FZNP
LM4040BEX3-3.0+T	3.000	0.2	100	-40°C to +125°C	3 SC70	ALO
LM4040CEX3-3.0+T	3.000	0.5	100	-40°C to +125°C	3 SC70	ALP
LM4040DEM3-3.0+T	3.000	1.0	150	-40°C to +125°C	3 SOT23	FZNR
LM4040DEX3-3.0+T	3.000	1.0	150	-40°C to +125°C	3 SC70	ALQ
LM4040AEX3-3.3+T	3.300	0.1	100	-40°C to +125°C	3 SC70	ANY
LM4040BEX3-3.3+T	3.300	0.2	100	-40°C to +125°C	3 SC70	ANZ
LM4040CEX3-3.3+T	3.300	0.5	100	-40°C to +125°C	3 SC70	AOA
LM4040DEX3-3.3+T	3.300	1.0	150	-40°C to +125°C	3 SC70	AOB
LM4040AIM3-4.1+T	4.096	0.1	100	-40°C to +85°C	3 SOT23	FZER
LM4040AIX3-4.1+T	4.096	0.1	100	-40°C to +85°C	3 SC70	ABV
LM4040BIM3-4.1+T	4.096	0.2	100	-40°C to +85°C	3 SOT23	FZES
LM4040BIX3-4.1+T	4.096	0.2	100	-40°C to +85°C	3 SC70	ABW
LM4040CIM3-4.1+T	4.096	0.5	100	-40°C to +85°C	3 SOT23	FZET
LM4040CIX3-4.1+T	4.096	0.5	100	-40°C to +85°C	3 SC70	ABX
LM4040DIM3-4.1+T	4.096	1.0	150	-40°C to +85°C	3 SOT23	FZEU
LM4040DIX3-4.1+T	4.096	1.0	150	-40°C to +85°C	3 SC70	ABY
LM4040AEM3-4.1+T	4.096	0.1	100	-40°C to +125°C	3 SOT23	FZNS
LM4040AEX3-4.1+T	4.096	0.1	100	-40°C to +125°C	3 SC70	ALR
LM4040BEM3-4.1+T	4.096	0.2	100	-40°C to +125°C	3 SOT23	FZNT
LM4040BEX3-4.1+T	4.096	0.2	100	-40°C to +125°C	3 SC70	ALS
LM4040CEM3-4.1+T	4.096	0.5	100	-40°C to +125°C	3 SOT23	FZNU
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⁺Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

Ordering Information (continued)

PART	OUTPUT VOLTAGE (V)	INITIAL ACCURACY (%)	TEMPCO (ppm/°C)	TEMP RANGE	PIN-PACKAGE	TOP MARK
LM4040CEX3-4.1+T	4.096	0.5	100	-40°C to +125°C	3 SC70	ALT
LM4040DEM3-4.1+T	4.096	1.0	150	-40°C to +125°C	3 SOT23	FZNV
LM4040DEM3-4.1/V+T	4.096	1.0	150	-40°C to +125°C	3 SOT23	FZWA
LM4040DEX3-4.1+T	4.096	1.0	150	-40°C to +125°C	3 SC70	ALU
LM4040AIM3-5.0+T	5.000	0.1	100	-40°C to +85°C	3 SOT23	FZEV
LM4040AIX3-5.0+T	5.000	0.1	100	-40°C to +85°C	3 SC70	ABZ
LM4040BIM3-5.0+T	5.000	0.2	100	-40°C to +85°C	3 SOT23	FZEW
LM4040BIX3-5.0+T	5.000	0.2	100	-40°C to +85°C	3 SC70	ACA
LM4040CIM3-5.0+T	5.000	0.5	100	-40°C to +85°C	3 SOT23	FZEX
LM4040CIX3-5.0+T	5.000	0.5	100	-40°C to +85°C	3 SC70	ACB
LM4040DIM3-5.0+T	5.000	1.0	150	-40°C to +85°C	3 SOT23	FZEY
LM4040DIX3-5.0+T	5.000	1.0	150	-40°C to +85°C	3 SC70	ACC
LM4040AEM3-5.0+T	5.000	0.1	100	-40°C to +125°C	3 SOT23	FZNW
LM4040AEM3-5.0/V+T	5.000	0.1	100	-40°C to +125°C	3 SOT23	FZWB
LM4040AEX3-5.0+T	5.000	0.1	100	-40°C to +125°C	3 SC70	ALV
LM4040BEM3-5.0+T	5.000	0.2	100	-40°C to +125°C	3 SOT23	FZNX
LM4040BEX3-5.0+T	5.000	0.2	100	-40°C to +125°C	3 SC70	ALW
LM4040CEM3-5.0+T	5.000	0.5	100	-40°C to +125°C	3 SOT23	FZNY
LM4040CEM3-5.0/V+T	5.000	0.5	100	-40°C to +125°C	3 SOT23	+FZWC
LM4040CEX3-5.0+T	5.000	0.5	100	-40°C to +125°C	3 SC70	ALX
LM4040DEM3-5.0+T	5.000	1.0	150	-40°C to +125°C	3 SOT23	FZNZ
LM4040DEX3-5.0+T	5.000	1.0	150	-40°C to +125°C	3 SC70	ALY

⁺Denotes a lead(Pb)-free/RoHS-compliant package.

PROCESS: BICMOS

Chip Information

Package Information

For the latest package outline information and land patterns (footprints), go to www.maxim-ic.com/packages. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
3 SOT23	U3+1	<u>21-0051</u>	<u>90-0179</u>
3 SC70	X3+2	21-0075	90-0208

T = Tape and reel.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/00	Initial release	_
5	7/05	Updated Electrical Characteristics.	2–7
6	4/11	Updated Selector Guide, Absolute Maximum Ratings, and Ordering Information.	1, 2, 12, 13, 14
7	11/11	Add /V+ automotive-qualified identification to the Selector Guide and Ordering Information.	1, 12

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